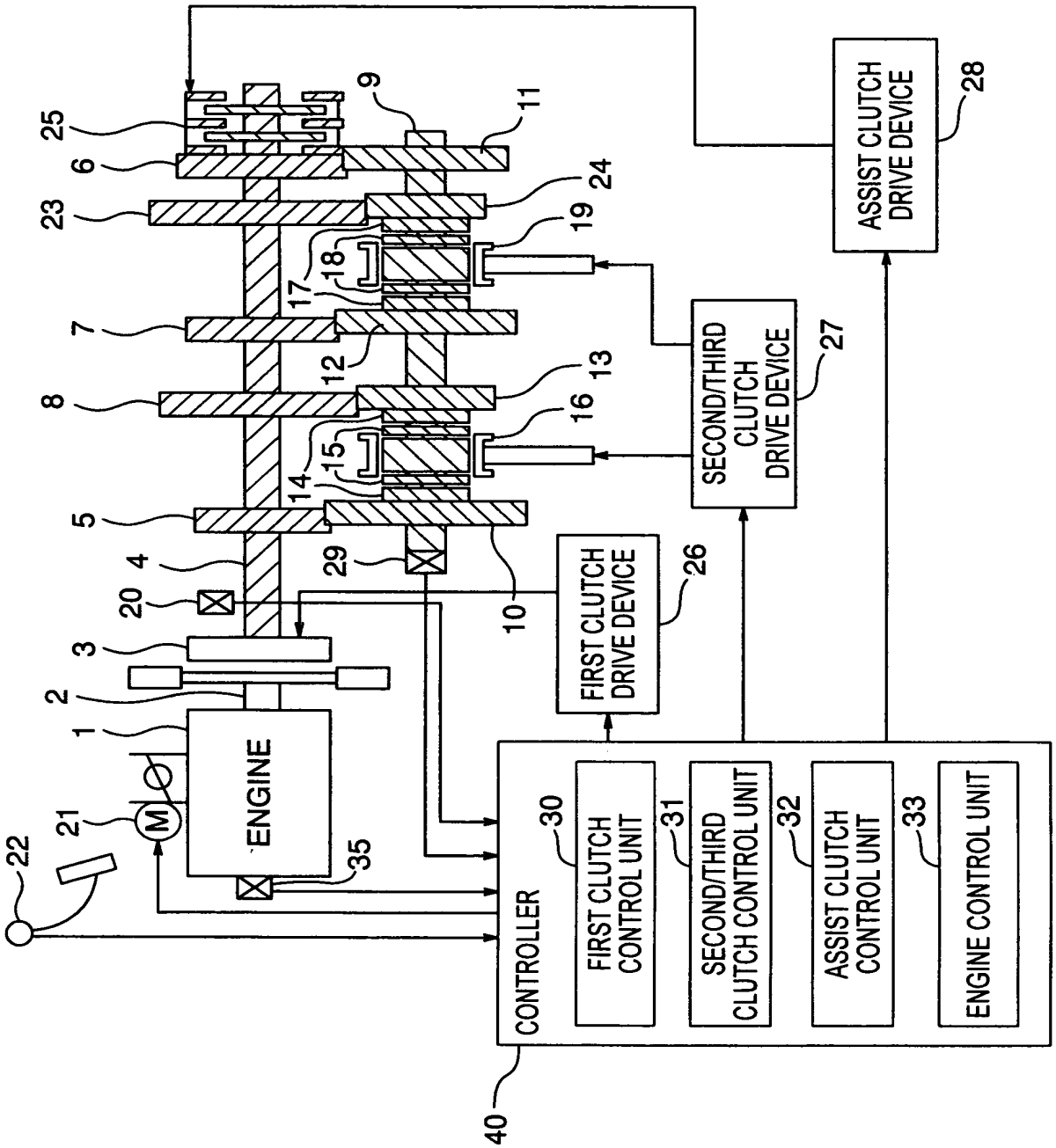
FIG. 1


ENGINE
M
CONTROLLER
FIRST CLUTCH CONTROL UNIT
SECOND/THIRD CLUTCH CONTROL UNIT
ASSIST CLUTCH CONTROL UNIT
ENGINE CONTROL UNIT
FIRST CLUTCH DRIVE DEVICE
SECOND/THIRD CLUTCH DRIVE DEVICE
ASSIST CLUTCH DRIVE DEVICE
1
2
3
4
5
6
7
8
9
10
11
12
13
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35
40

FIG. 2

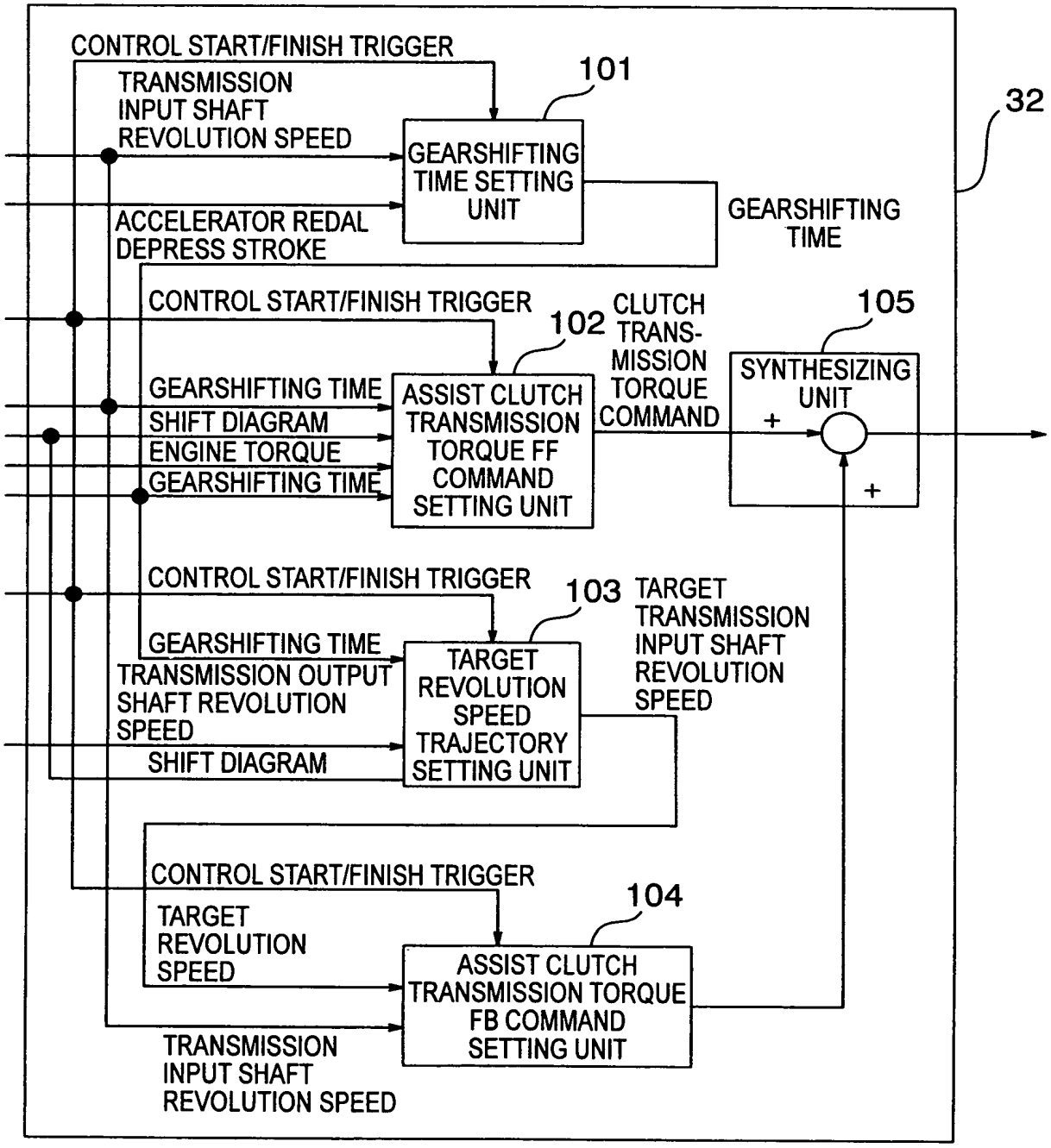

CONTROL START/FINISH TRIGGER
TRANSMISSION INPUT SHAFT REVOLUTION SPEED
ACCELERATOR REDAL DEPRESS STROKE
101
GEARSHIFTING TIME SETTING UNIT
GEARSHIFTING TIME
32
CONTROL START/FINISH TRIGGER
GEARSHIFTING TIME
SHIFT DIAGRAM
ENGINE TORQUE
GEARSHIFTING TIME
102
ASSIST CLUTCH TRANSMISSION TORQUE FF COMMAND SETTING UNIT
CLUTCH TRANS-MISSION TORQUE COMMAND
105
SYNTHESIZING UNIT
+
+
CONTROL START/FINISH TRIGGER
GEARSHIFTING TIME
TRANSMISSION OUTPUT SHAFT REVOLUTION SPEED
SHIFT DIAGRAM
103
TARGET REVOLUTION SPEED TRAJECTORY SETTING UNIT
TARGET TRANSMISSION INPUT SHAFT REVOLUTION SPEED
CONTROL START/FINISH TRIGGER
TARGET REVOLUTION SPEED
TRANSMISSION INPUT SHAFT REVOLUTION SPEED
104
ASSIST CLUTCH TRANSMISSION TORQUE FB COMMAND SETTING UNIT

FIG. 3

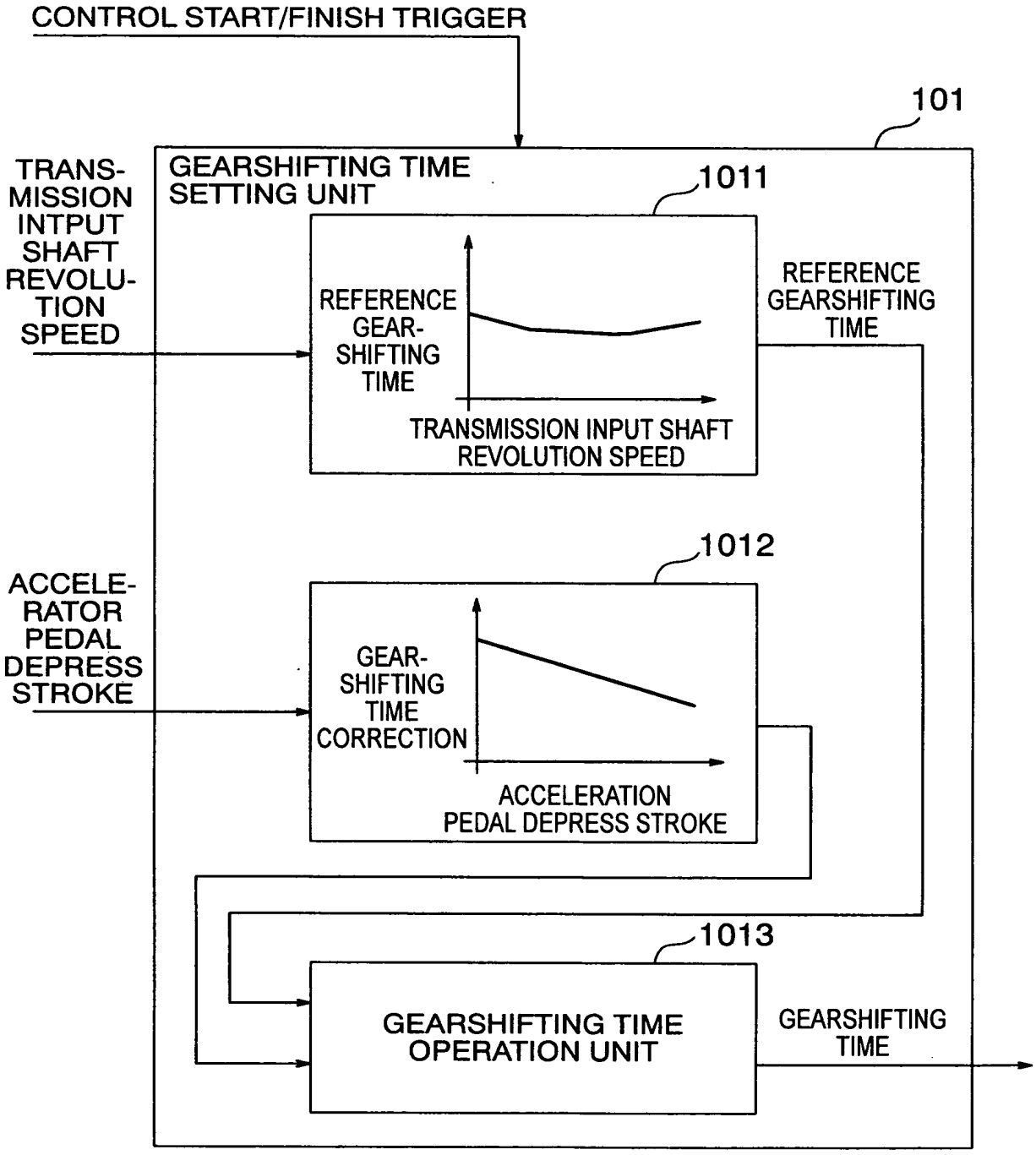

CONTROL START/FINISH TRIGGER
101
TRANS-MISSION INTPUT SHAFT REVOLU-TION SPEED
GEARSHIFTING TIME SETTING UNIT
1011
REFERENCE GEAR-SHIFTING TIME
TRANSMISSION INPUT SHAFT REVOLUTION SPEED
REFERENCE GEARSHIFTING TIME
1012
ACCELE-RATOR PEDAL DEPRESS STROKE
GEAR-SHIFTING TIME CORRECTION
ACCELERATION PEDAL DEPRESS STROKE
1013
GEARSHIFTING TIME OPERATION UNIT
GEARSHIFTING TIME

FIG. 4

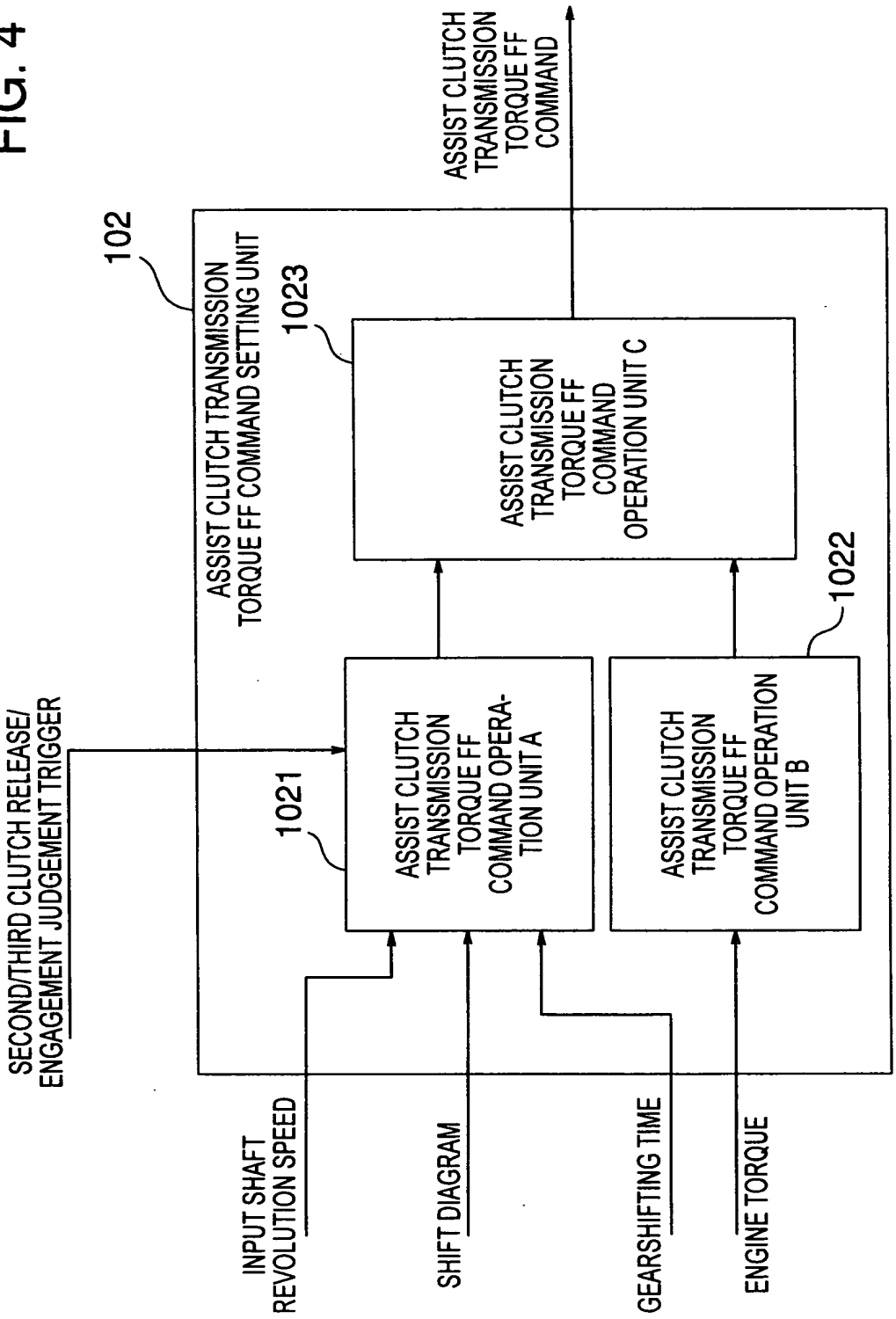

ASSIST CLUTCH TRANSMISSION TORQUE FF COMMAND
102
ASSIST CLUTCH TRANSMISSION TORQUE FF COMMAND SETTING UNIT
1023
ASSIST CLUTCH TRANSMISSION TORQUE FF COMMAND OPERATION UNIT C
1022
1021
ASSIST CLUTCH TRANSMISSION TORQUE FF COMMAND OPERATION UNIT A
ASSIST CLUTCH TRANSMISSION TORQUE FF COMMAND OPERATION UNIT B
SECOND/THIRD CLUTCH RELEASE/ ENGAGEMENT JUDGEMENT TRIGGER
INPUT SHAFT REVOLUTION SPEED
SHIFT DIAGRAM
GEARSHIFTING TIME
ENGINE TORQUE

FIG. 5

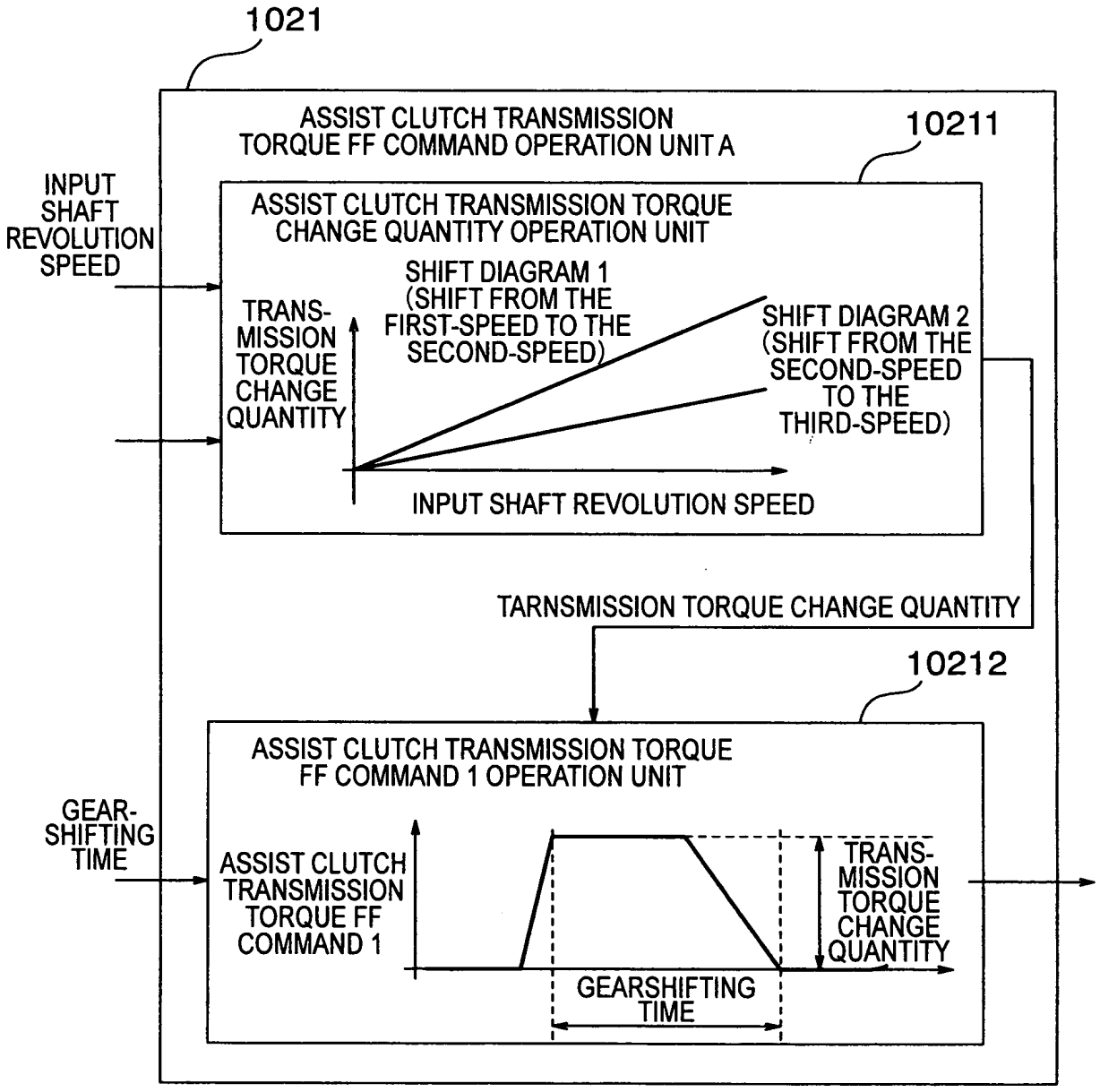

1021
ASSIST CLUTCH TRANSMISSION TORQUE FF COMMAND OPERATION UNIT A
10211
INPUT SHAFT REVOLUTION SPEED
ASSIST CLUTCH TRANSMISSION TORQUE CHANGE QUANTITY OPERATION UNIT
SHIFT DIAGRAM 1 (SHIFT FROM THE FIRST-SPEED TO THE SECOND-SPEED)
SHIFT DIAGRAM 2 (SHIFT FROM THE SECOND-SPEED TO THE THIRD-SPEED)
TRANS-MISSION TORQUE CHANGE QUANTITY
INPUT SHAFT REVOLUTION SPEED
TARNSMISSION TORQUE CHANGE QUANTITY
10212
ASSIST CLUTCH TRANSMISSION TORQUE FF COMMAND 1 OPERATION UNIT
GEAR-SHIFTING TIME
ASSIST CLUTCH TRANSMISSION TORQUE FF COMMAND 1
TRANS-MISSION TORQUE CHANGE QUANTITY
GEARSHIFTING TIME

FIG. 6

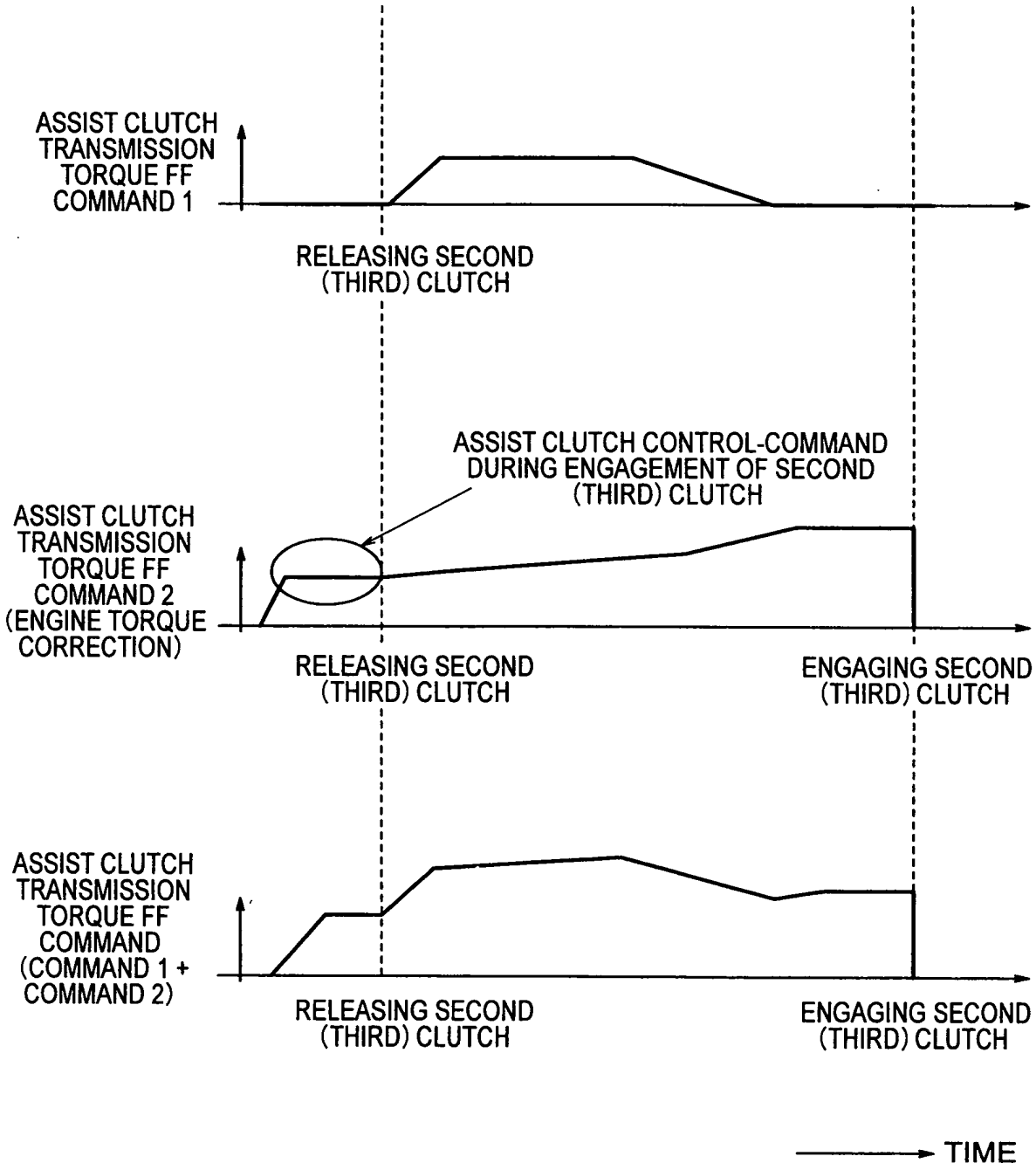

ASSIST CLUTCH TRANSMISSION TORQUE FF COMMAND 1
RELEASING SECOND (THIRD) CLUTCH
ASSIST CLUTCH CONTROL-COMMAND DURING ENGAGEMENT OF SECOND (THIRD) CLUTCH
ASSIST CLUTCH TRANSMISSION TORQUE FF COMMAND 2 (ENGINE TORQUE CORRECTION)
RELEASING SECOND (THIRD) CLUTCH
ENGAGING SECOND (THIRD) CLUTCH
ASSIST CLUTCH TRANSMISSION TORQUE FF COMMAND (COMMAND 1 + COMMAND 2)
RELEASING SECOND (THIRD) CLUTCH
ENGAGING SECOND (THIRD) CLUTCH
TIME

FIG. 7

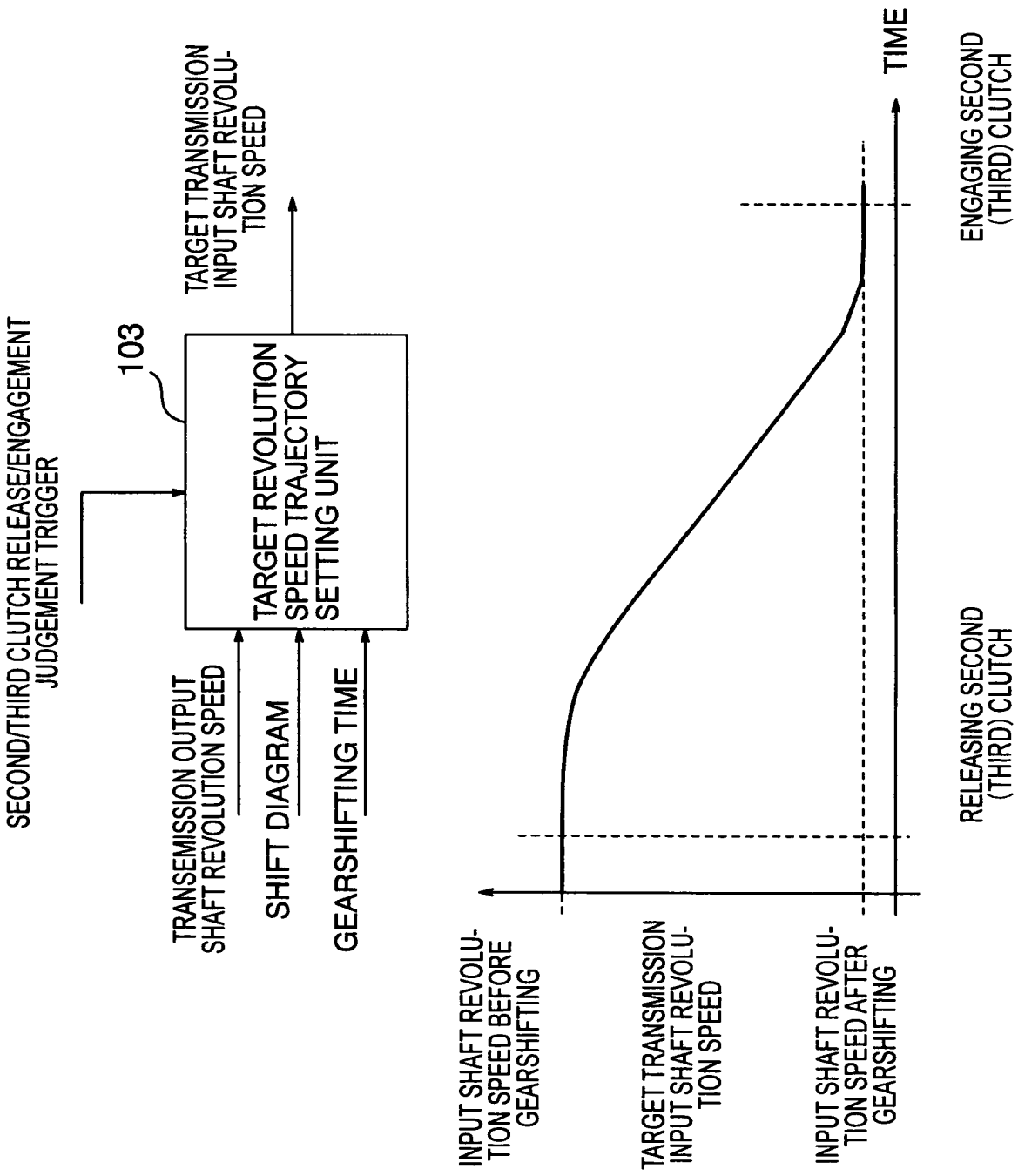
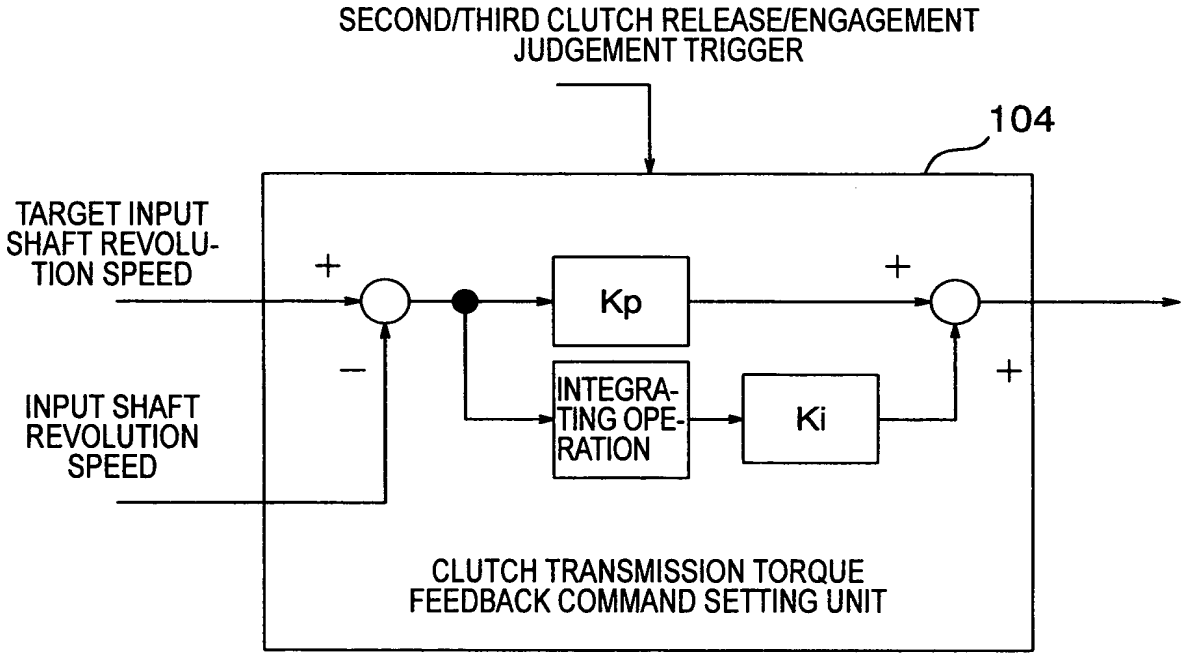

SECOND/THIRD CLUTCH RELEASE/ENGAGEMENT JUDGEMENT TRIGGER
103
TARGET REVOLUTION SPEED TRAJECTORY SETTING UNIT
TARGET TRANSMISSION INPUT SHAFT REVOLUTION SPEED
TRANSEMISSION OUTPUT SHAFT REVOLUTION SPEED
SHIFT DIAGRAM
GEARSHIFTING TIME
TIME
ENGAGING SECOND (THIRD) CLUTCH
RELEASING SECOND (THIRD) CLUTCH
INPUT SHAFT REVOLUTION SPEED BEFORE GEARSHIFTING
TARGET TRANSMISSION INPUT SHAFT REVOLUTION SPEED
INPUT SHAFT REVOLUTION SPEED AFTER GEARSHIFTING

FIG. 8


SECOND/THIRD CLUTCH RELEASE/ENGAGEMENT JUDGEMENT TRIGGER
104
TARGET INPUT SHAFT REVOLUTION SPEED
INPUT SHAFT REVOLUTION SPEED
+
−
Kp
INTEGRATING OPERATION
Ki
+
+
CLUTCH TRANSMISSION TORQUE FEEDBACK COMMAND SETTING UNIT

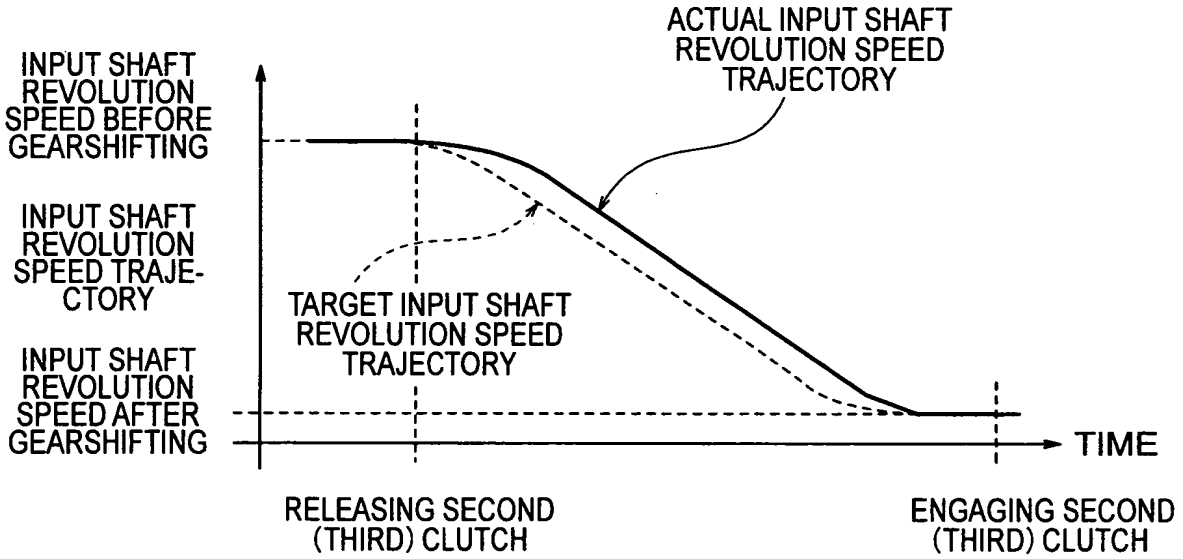
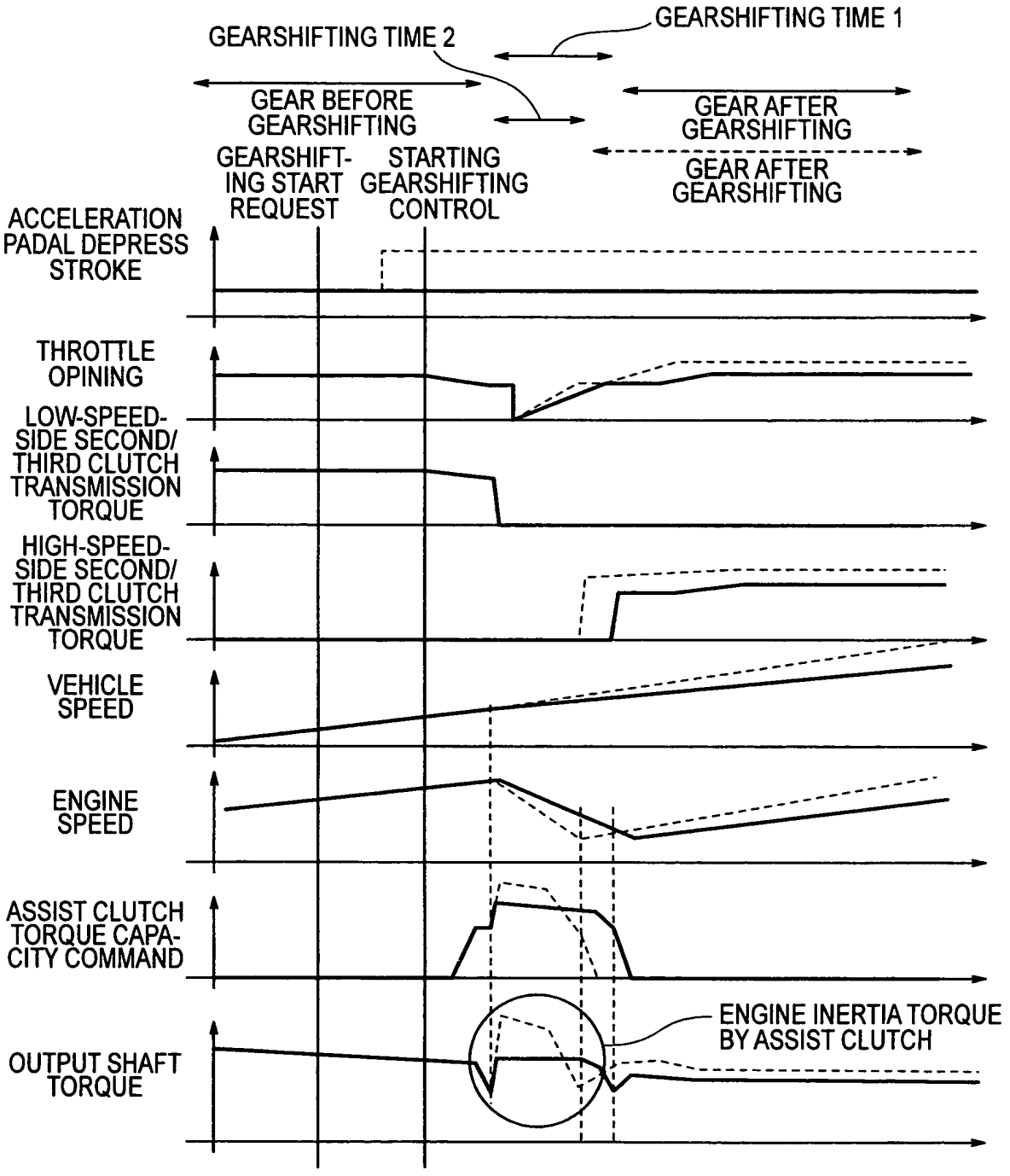

ACTUAL INPUT SHAFT REVOLUTION SPEED TRAJECTORY
INPUT SHAFT REVOLUTION SPEED BEFORE GEARSHIFTING
INPUT SHAFT REVOLUTION SPEED TRAJECTORY
TARGET INPUT SHAFT REVOLUTION SPEED TRAJECTORY
INPUT SHAFT REVOLUTION SPEED AFTER GEARSHIFTING
TIME
RELEASING SECOND (THIRD) CLUTCH
ENGAGING SECOND (THIRD) CLUTCH

FIG. 9



---------- : IN THE CASE WHERE IN ACCELERATION REDAL DEPRESS STROKE IS CHANGED DURING THE PERIOD BETWEEN THE GEARSHIFTING START REQUEST AND THE START OF GEARSHIFTING

———— : IN THE CASE WHERE THERE IS NO CHANGE IN ACCELERATION REDAL DEPRESS STROKE DURING THE PERIOD BETWEEN THE GEARSHIFTING START REQUEST AND THE START OF GEARSHIFTING

FIG. 10

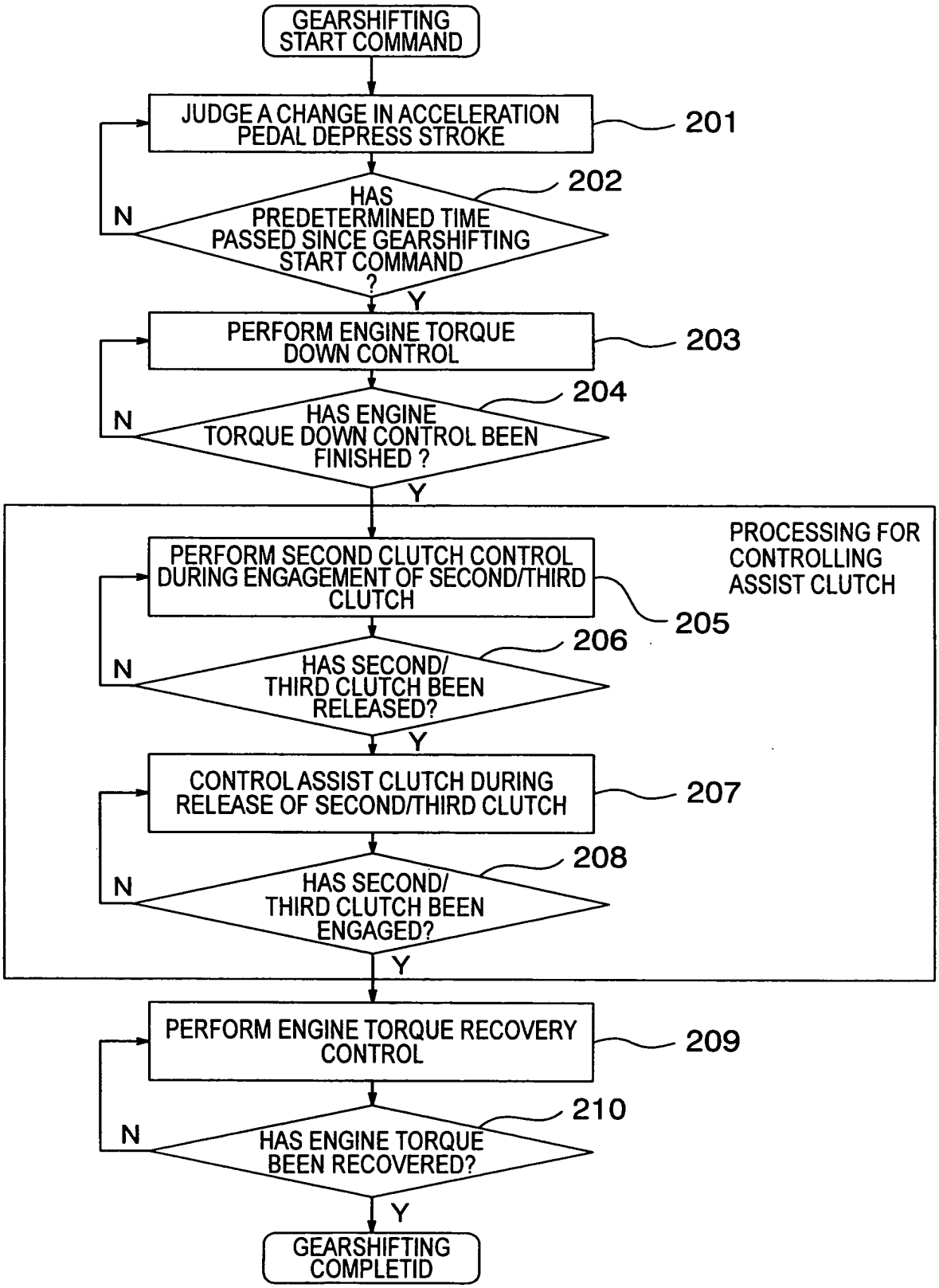

GEARSHIFTING START COMMAND
JUDGE A CHANGE IN ACCELERATION PEDAL DEPRESS STROKE
201
HAS PREDETERMINED TIME PASSED SINCE GEARSHIFTING START COMMAND ?
202
N
Y
PERFORM ENGINE TORQUE DOWN CONTROL
203
HAS ENGINE TORQUE DOWN CONTROL BEEN FINISHED ?
204
N
Y
PROCESSING FOR CONTROLLING ASSIST CLUTCH
PERFORM SECOND CLUTCH CONTROL DURING ENGAGEMENT OF SECOND/THIRD CLUTCH
205
HAS SECOND/ THIRD CLUTCH BEEN RELEASED?
206
N
Y
CONTROL ASSIST CLUTCH DURING RELEASE OF SECOND/THIRD CLUTCH
207
HAS SECOND/ THIRD CLUTCH BEEN ENGAGED?
208
N
Y
PERFORM ENGINE TORQUE RECOVERY CONTROL
209
HAS ENGINE TORQUE BEEN RECOVERED?
210
N
Y
GEARSHIFTING COMPLETID

FIG. 11

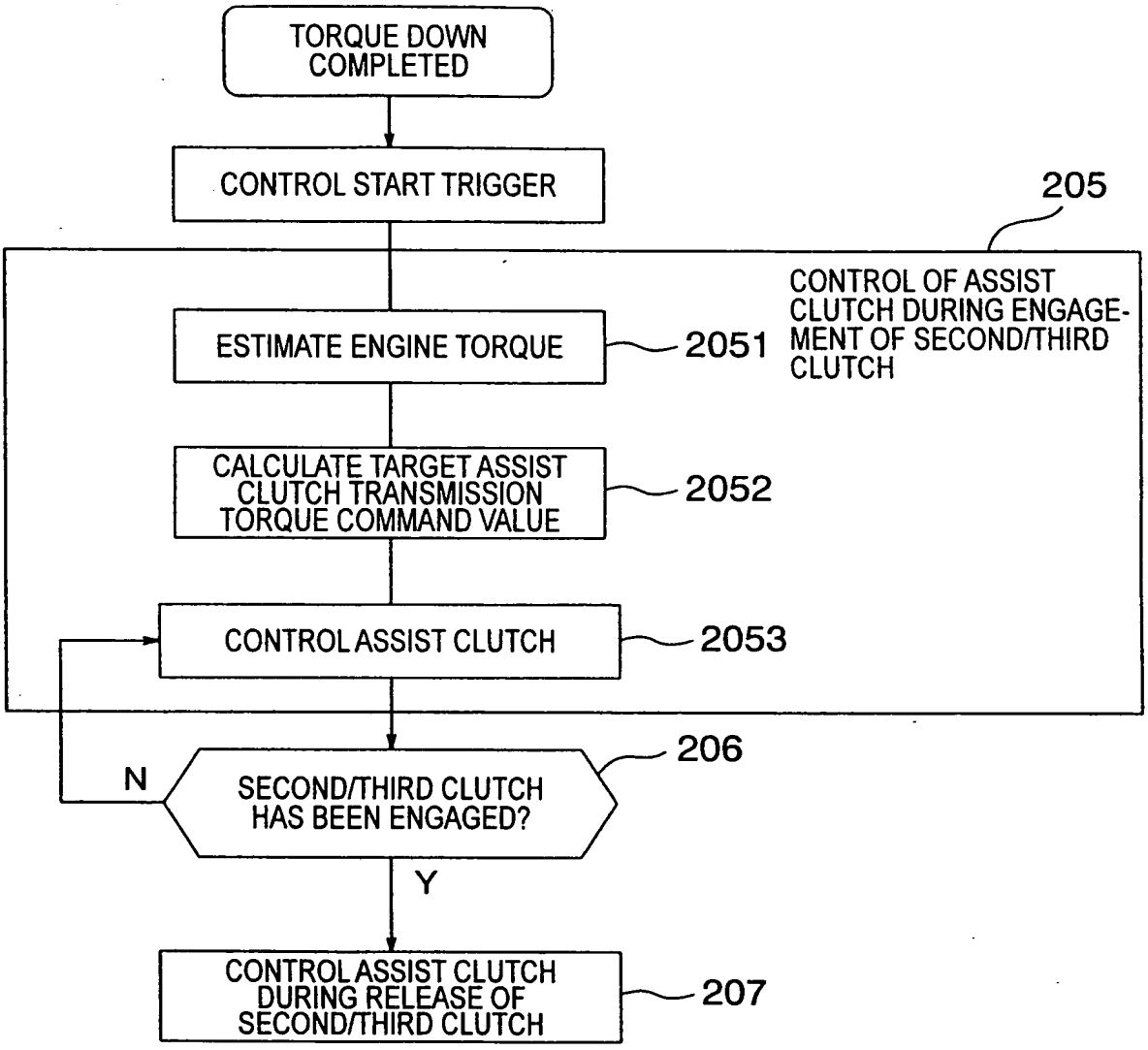

TORQUE DOWN COMPLETED
CONTROL START TRIGGER
205
CONTROL OF ASSIST CLUTCH DURING ENGAGEMENT OF SECOND/THIRD CLUTCH
ESTIMATE ENGINE TORQUE
2051
CALCULATE TARGET ASSIST CLUTCH TRANSMISSION TORQUE COMMAND VALUE
2052
CONTROL ASSIST CLUTCH
2053
206
N
SECOND/THIRD CLUTCH HAS BEEN ENGAGED?
Y
CONTROL ASSIST CLUTCH DURING RELEASE OF SECOND/THIRD CLUTCH
207

FIG. 12

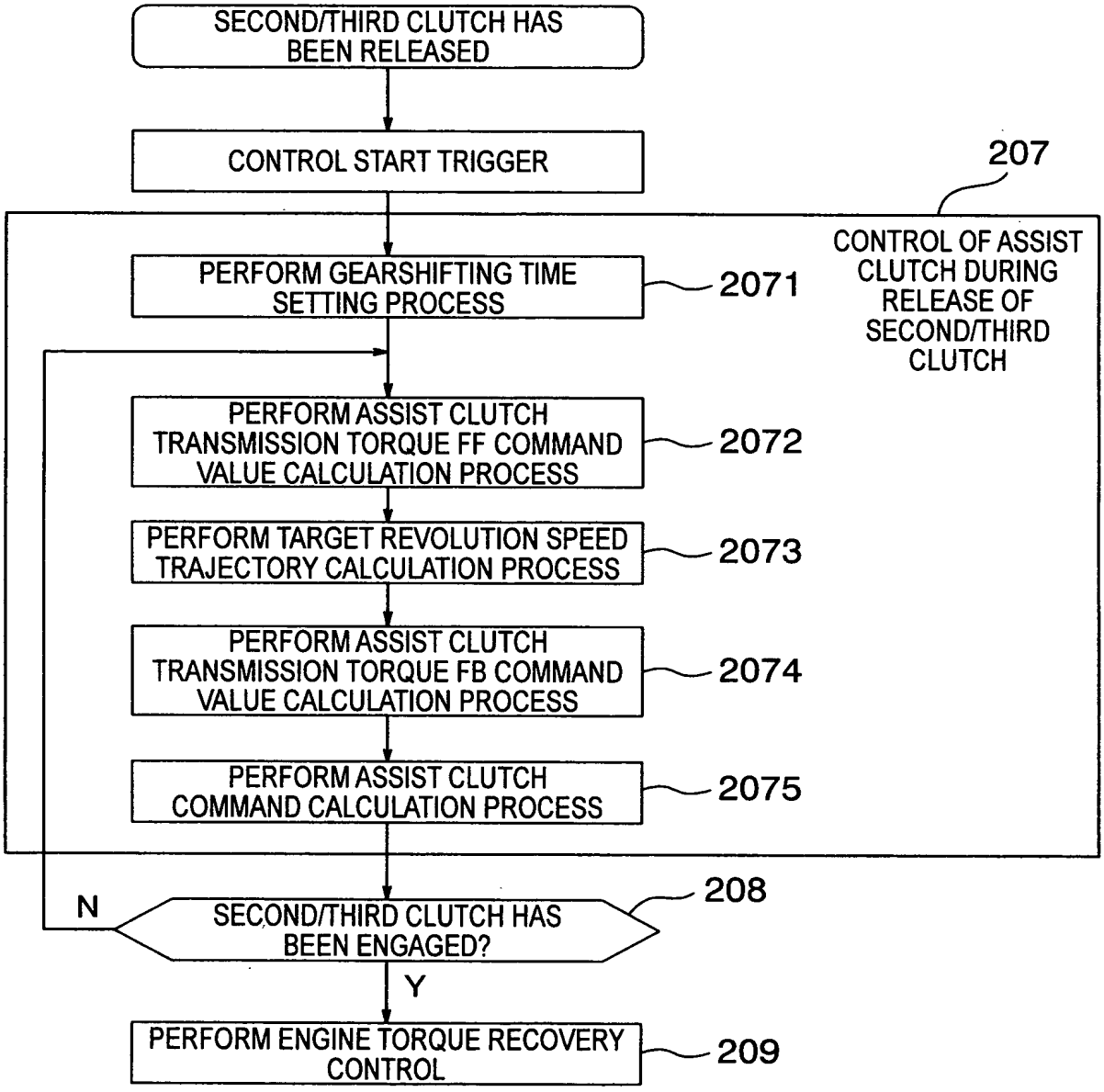

SECOND/THIRD CLUTCH HAS BEEN RELEASED
CONTROL START TRIGGER
207
CONTROL OF ASSIST CLUTCH DURING RELEASE OF SECOND/THIRD CLUTCH
PERFORM GEARSHIFTING TIME SETTING PROCESS
2071
PERFORM ASSIST CLUTCH TRANSMISSION TORQUE FF COMMAND VALUE CALCULATION PROCESS
2072
PERFORM TARGET REVOLUTION SPEED TRAJECTORY CALCULATION PROCESS
2073
PERFORM ASSIST CLUTCH TRANSMISSION TORQUE FB COMMAND VALUE CALCULATION PROCESS
2074
PERFORM ASSIST CLUTCH COMMAND CALCULATION PROCESS
2075
N
SECOND/THIRD CLUTCH HAS BEEN ENGAGED?
208
Y
PERFORM ENGINE TORQUE RECOVERY CONTROL
209

FIG. 13

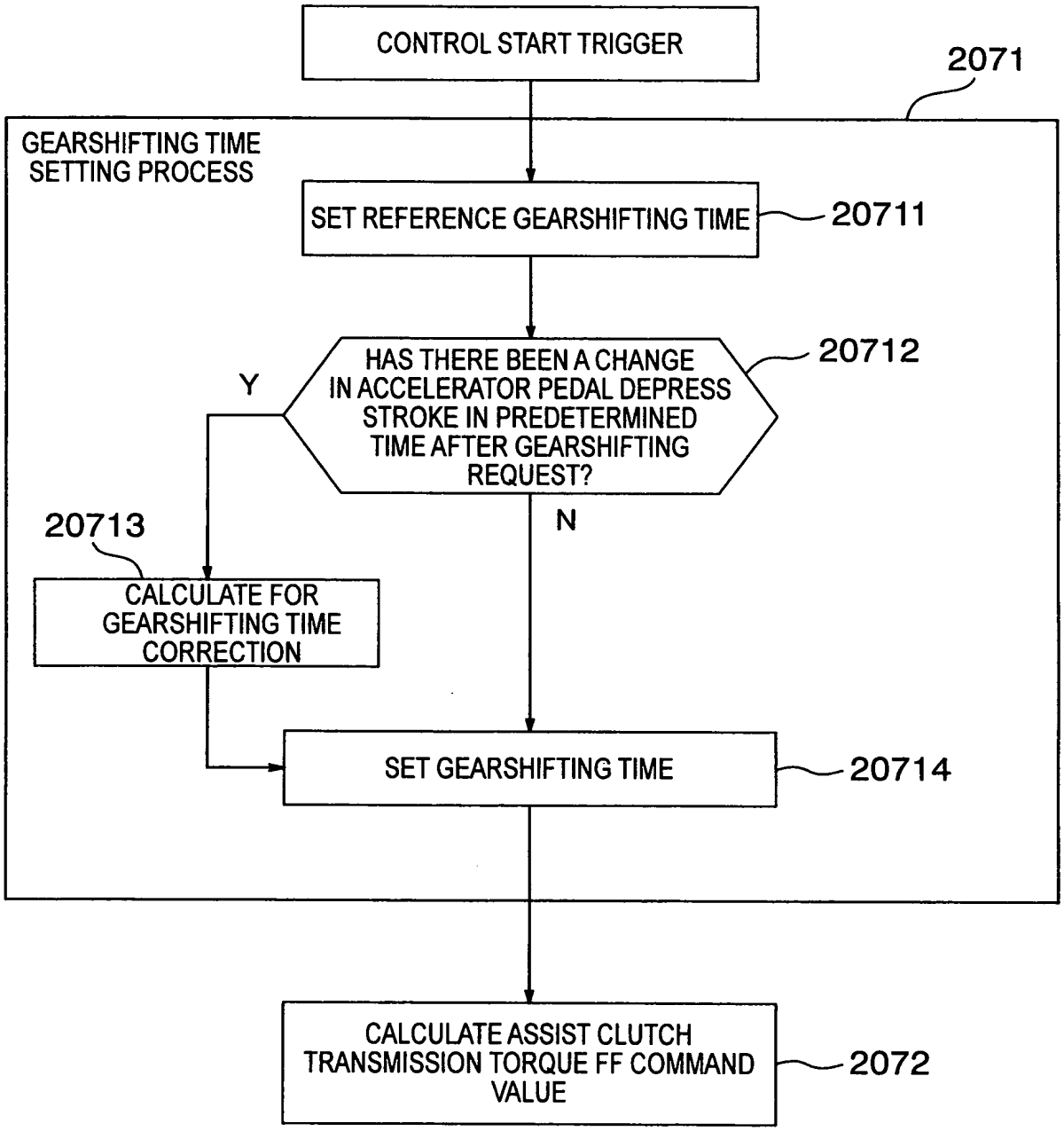

CONTROL START TRIGGER
2071
GEARSHIFTING TIME SETTING PROCESS
SET REFERENCE GEARSHIFTING TIME
20711
HAS THERE BEEN A CHANGE IN ACCELERATOR PEDAL DEPRESS STROKE IN PREDETERMINED TIME AFTER GEARSHIFTING REQUEST?
20712
Y
N
20713
CALCULATE FOR GEARSHIFTING TIME CORRECTION
SET GEARSHIFTING TIME
20714
CALCULATE ASSIST CLUTCH TRANSMISSION TORQUE FF COMMAND VALUE
2072

FIG. 14

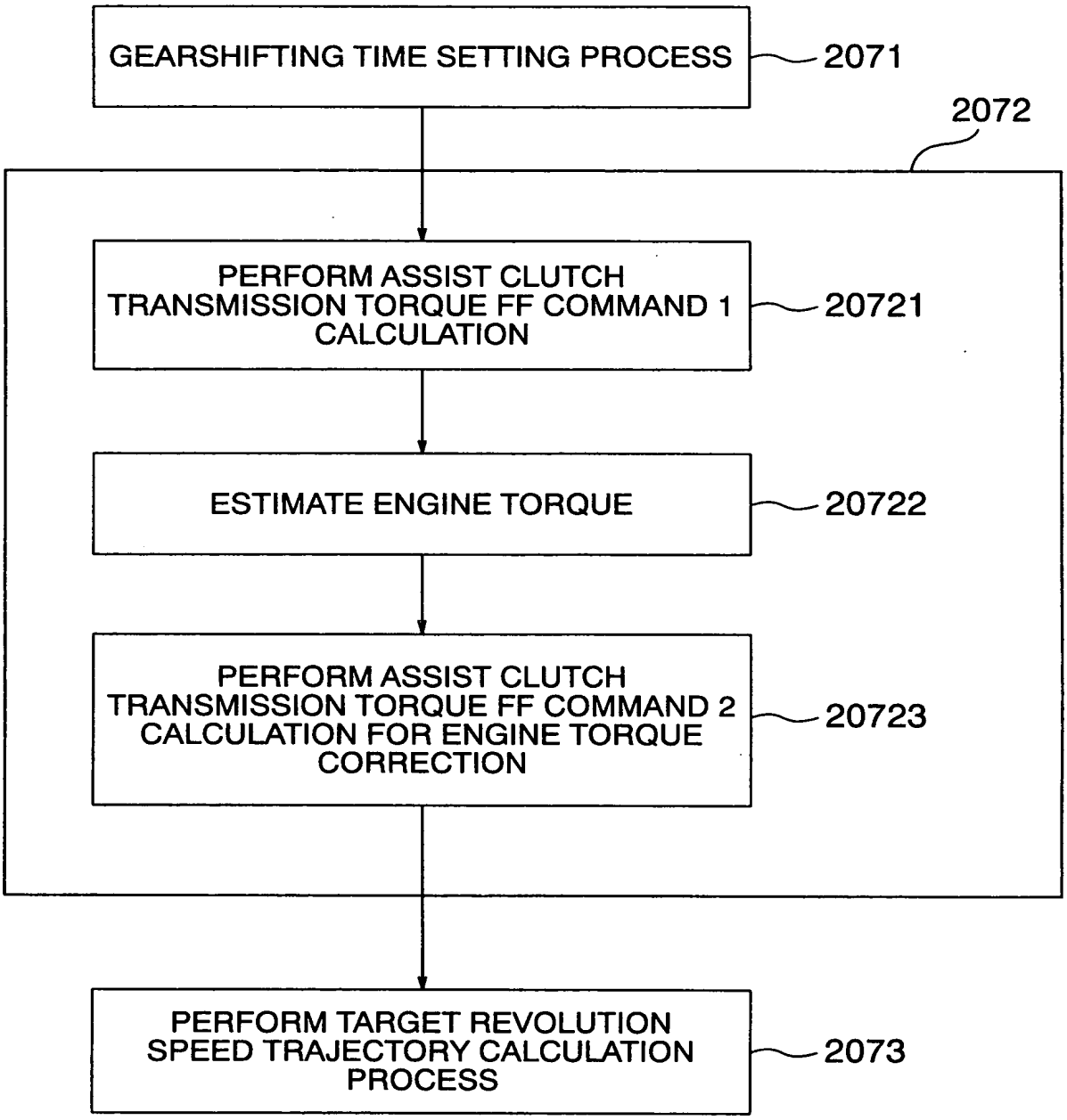

GEARSHIFTING TIME SETTING PROCESS
2071
2072
PERFORM ASSIST CLUTCH TRANSMISSION TORQUE FF COMMAND 1 CALCULATION
20721
ESTIMATE ENGINE TORQUE
20722
PERFORM ASSIST CLUTCH TRANSMISSION TORQUE FF COMMAND 2 CALCULATION FOR ENGINE TORQUE CORRECTION
20723
PERFORM TARGET REVOLUTION SPEED TRAJECTORY CALCULATION PROCESS
2073

FIG. 15

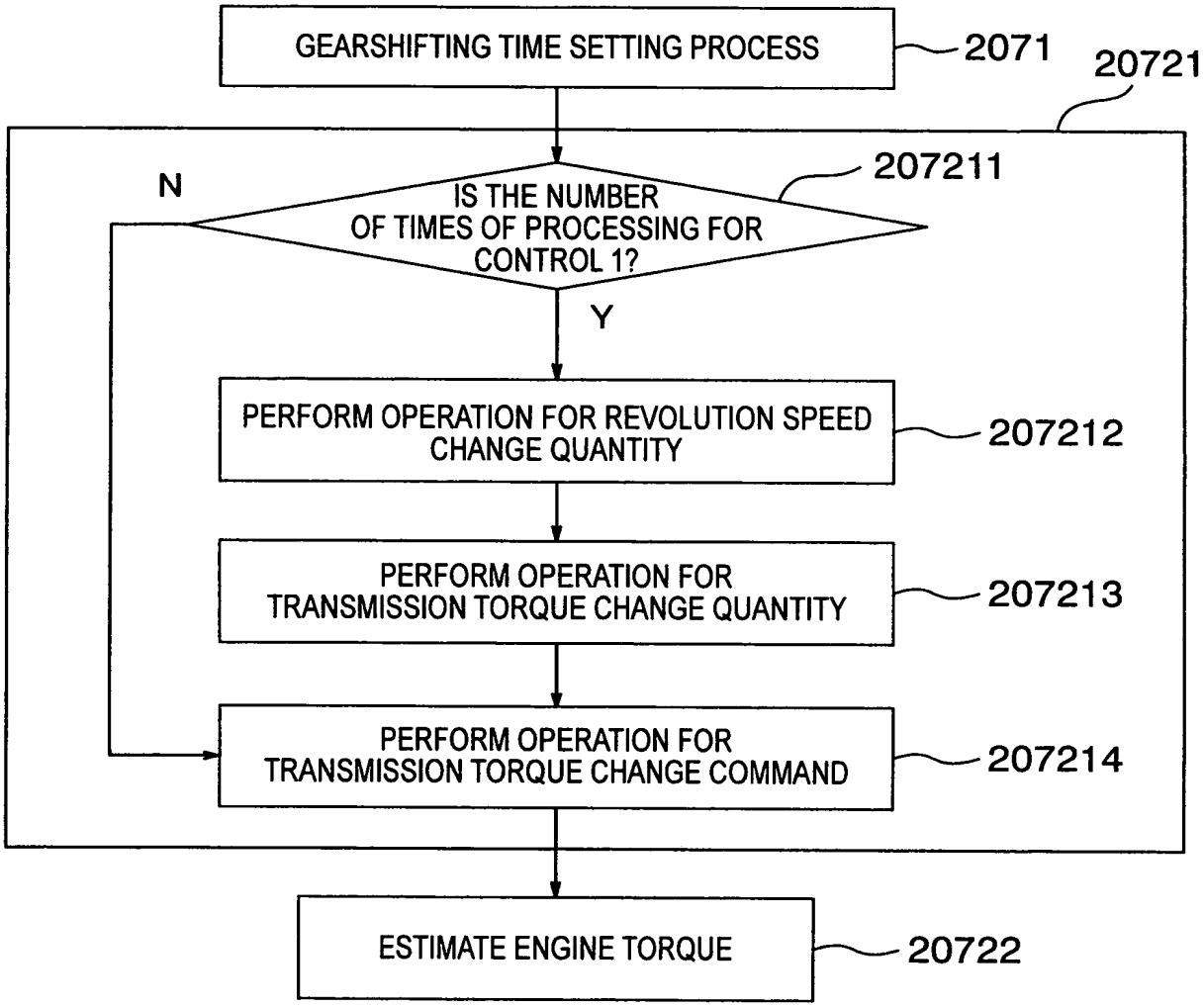
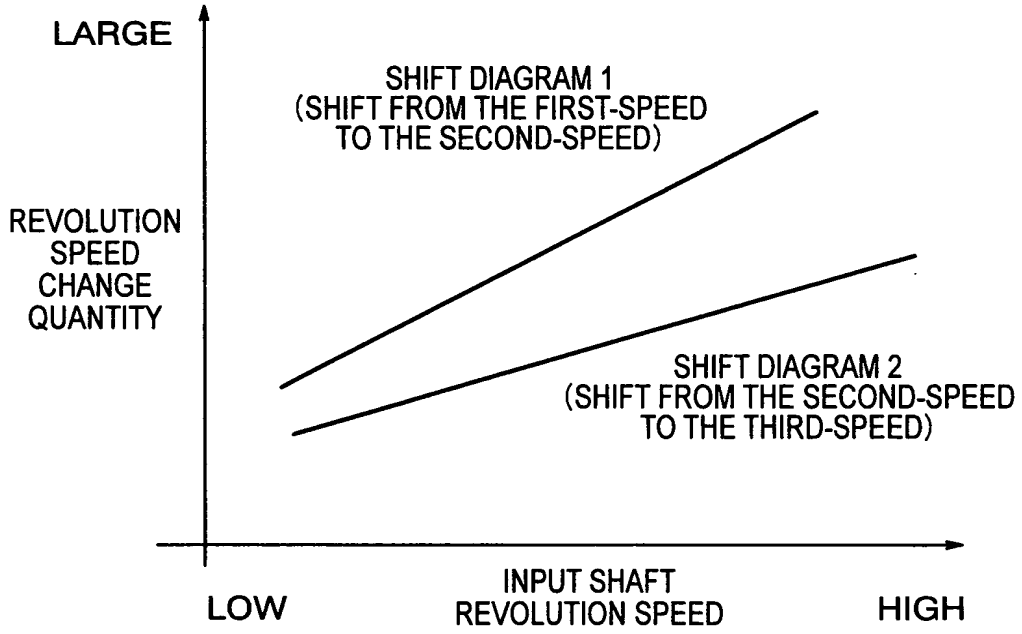
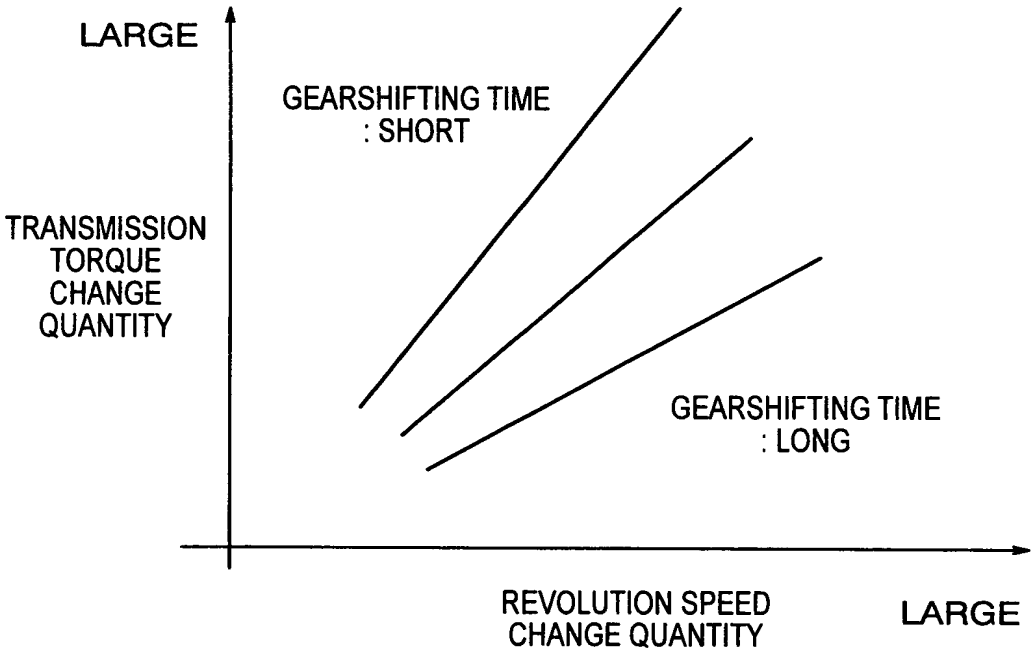

GEARSHIFTING TIME SETTING PROCESS
2071
20721
207211
N
IS THE NUMBER OF TIMES OF PROCESSING FOR CONTROL 1?
Y
PERFORM OPERATION FOR REVOLUTION SPEED CHANGE QUANTITY
207212
PERFORM OPERATION FOR TRANSMISSION TORQUE CHANGE QUANTITY
207213
PERFORM OPERATION FOR TRANSMISSION TORQUE CHANGE COMMAND
207214
ESTIMATE ENGINE TORQUE
20722

FIG. 16



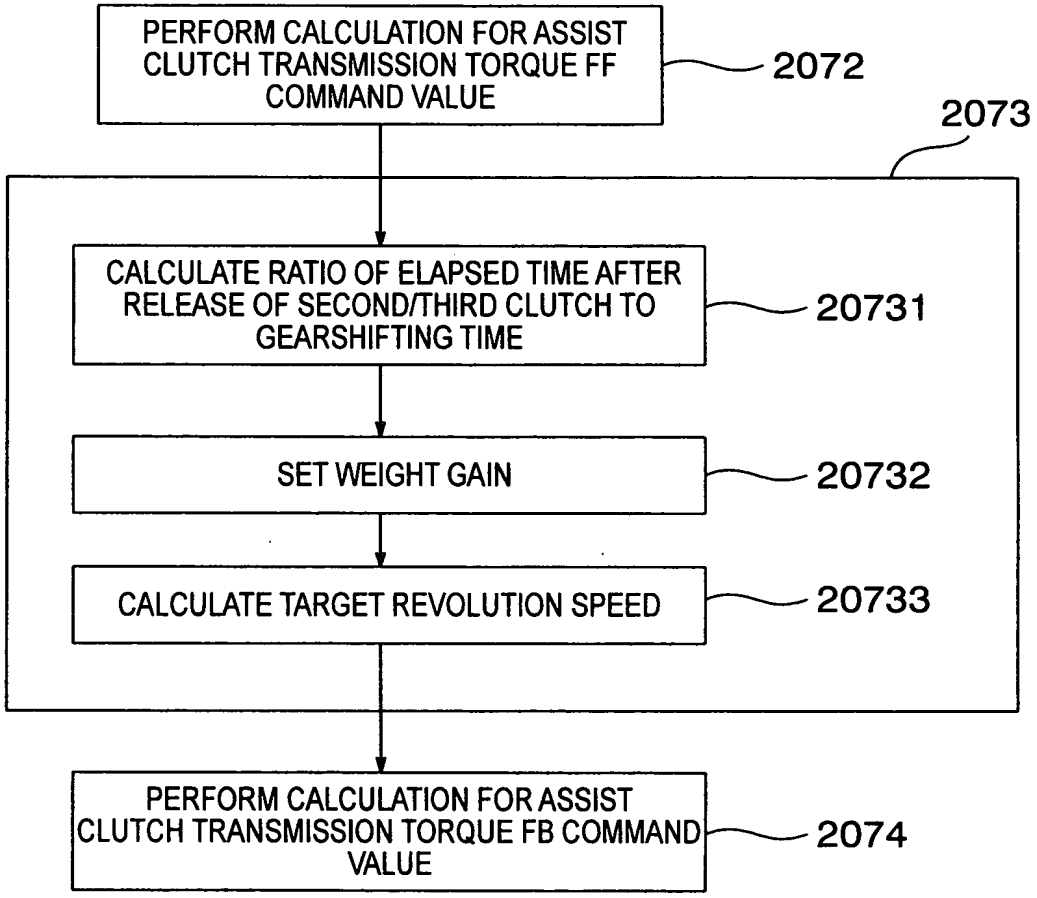
REVOLUTION SPEED CHANGE QUANTITY=
INPUT SHAFT REVOLUTION SPEED × (1-GEAR RATIO AFTER GEASHIFTING/GEAR RATIO BEFORE GEARSHIFTING)

FIG. 17



TRANSMISSION TORQUE CHANGE QUANTITY=
INERTIA × SECOND CLUTCH GEAR RATIO ×
REVOLUTION SPEED CHANGE QUANTITY/GEARSHIFTING TIME

FIG. 18



TARGET REVOLUTION SPEED = {(1-G) × GEAR RATIO BEFORE GEARSHIFTING + G × GEAR RATIO AFTER GEARSHIFTING} × OUTPUT SHAFT REVOLUTION SPEED

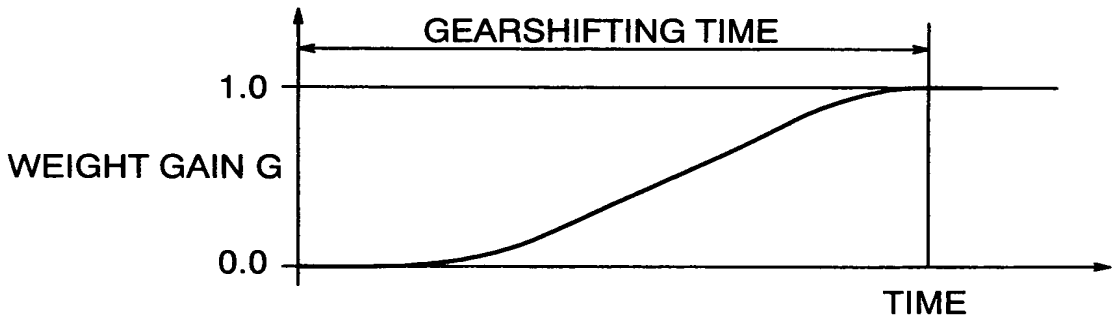


FIG. 19

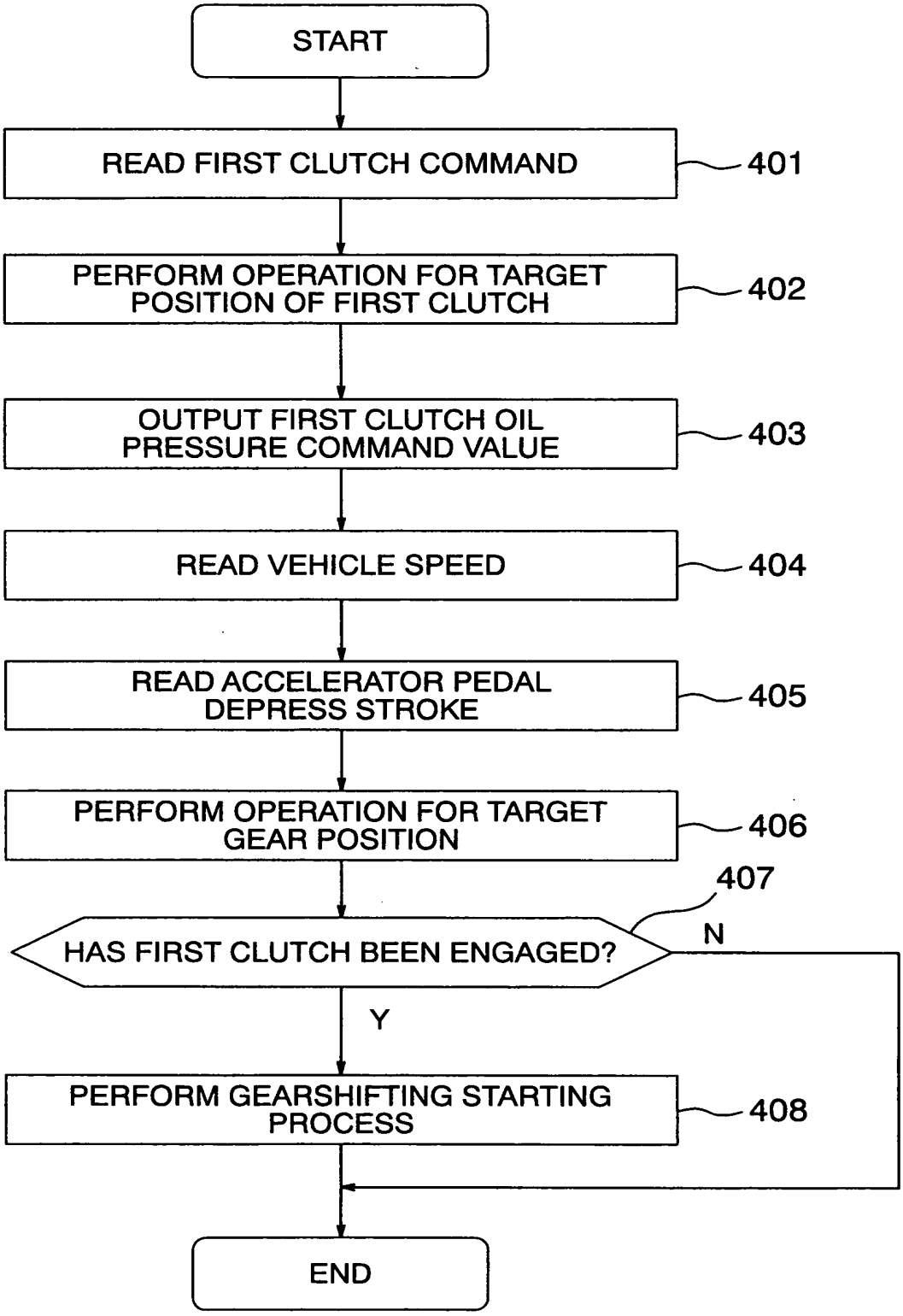

START
READ FIRST CLUTCH COMMAND
401
PERFORM OPERATION FOR TARGET POSITION OF FIRST CLUTCH
402
OUTPUT FIRST CLUTCH OIL PRESSURE COMMAND VALUE
403
READ VEHICLE SPEED
404
READ ACCELERATOR PEDAL DEPRESS STROKE
405
PERFORM OPERATION FOR TARGET GEAR POSITION
406
407
HAS FIRST CLUTCH BEEN ENGAGED?
N
Y
PERFORM GEARSHIFTING STARTING PROCESS
408
END

FIG. 20

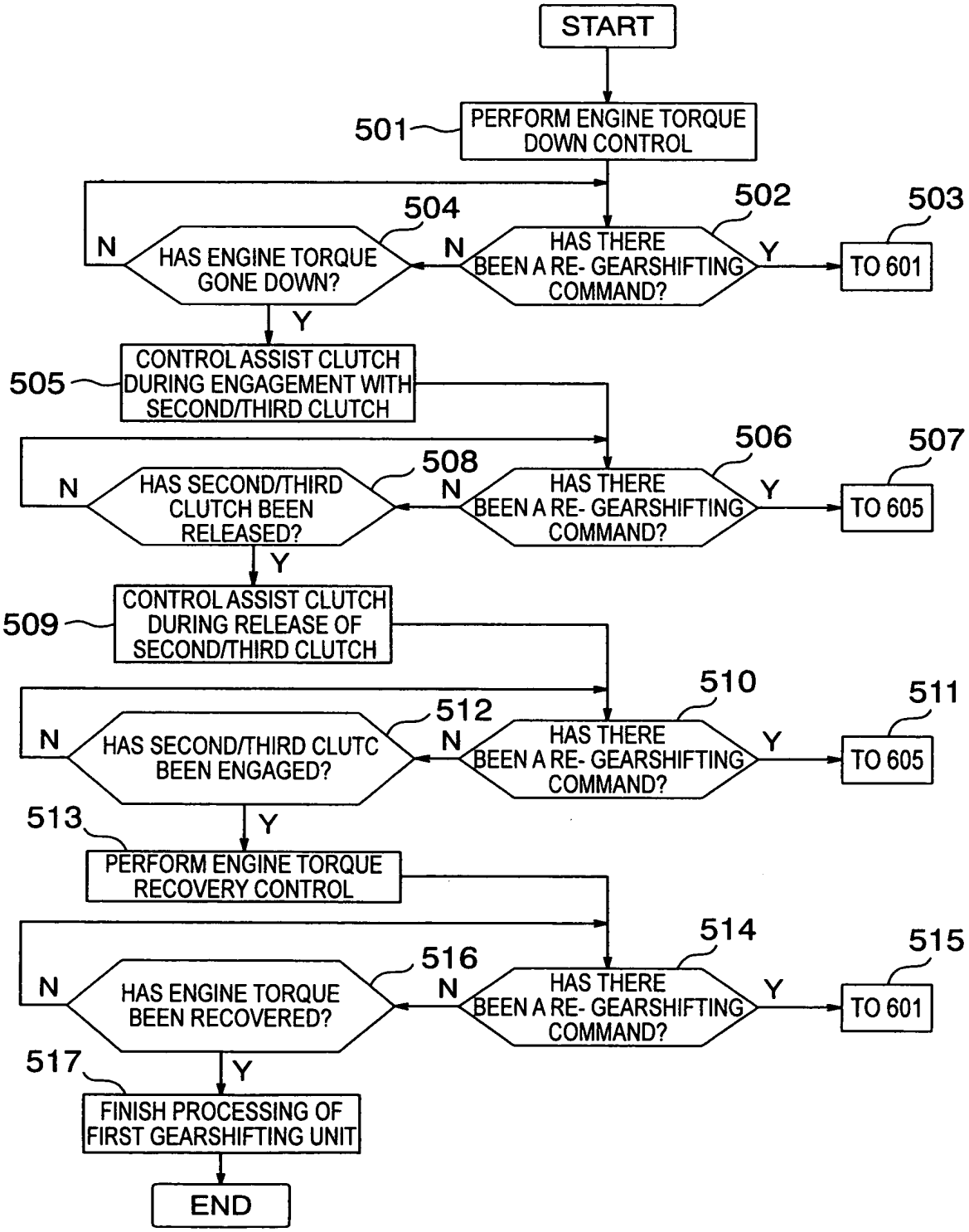
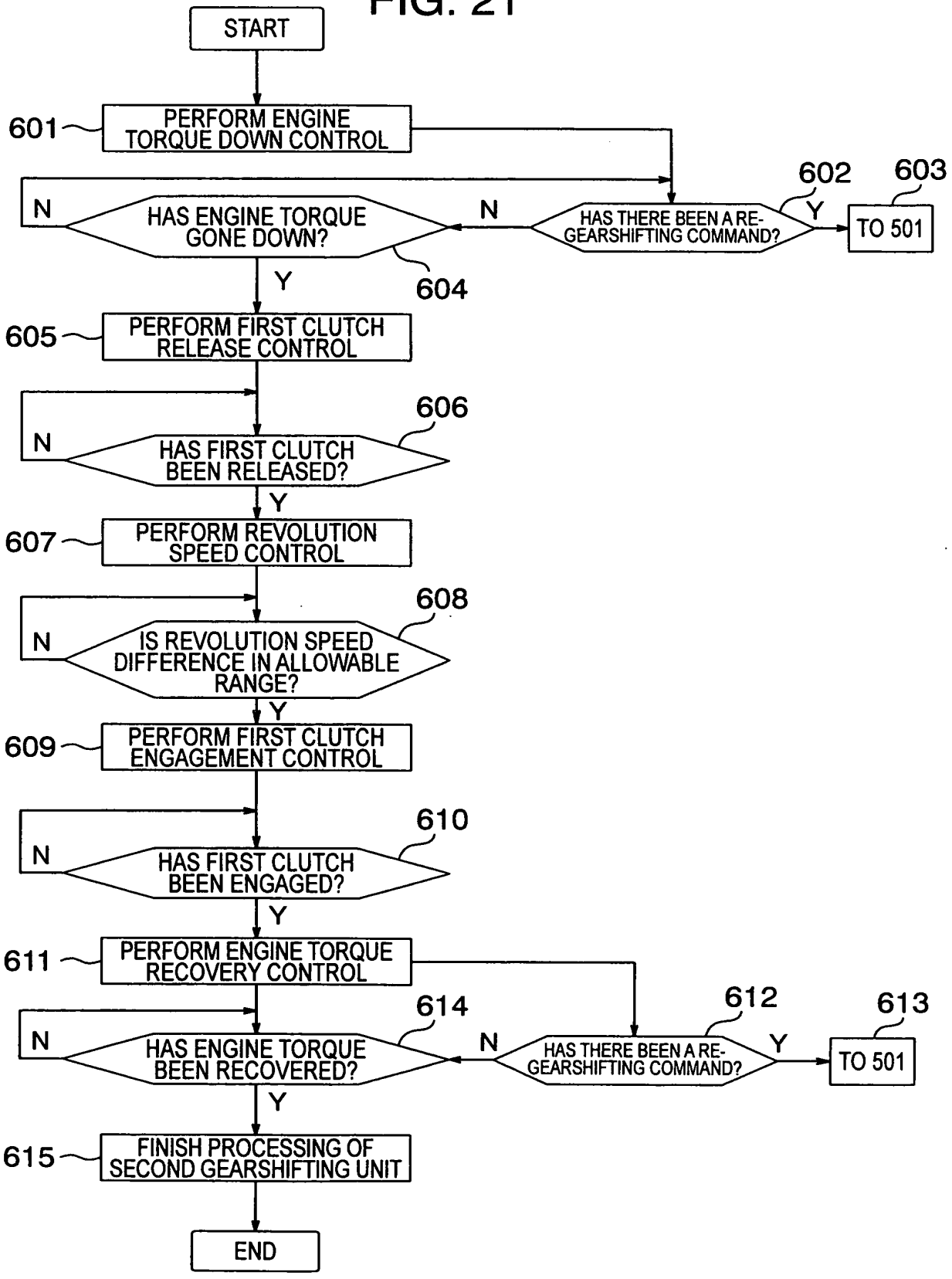

START
501
PERFORM ENGINE TORQUE DOWN CONTROL
502
HAS THERE BEEN A RE- GEARSHIFTING COMMAND?
N
Y
503
TO 601
504
HAS ENGINE TORQUE GONE DOWN?
N
Y
505
CONTROL ASSIST CLUTCH DURING ENGAGEMENT WITH SECOND/THIRD CLUTCH
506
HAS THERE BEEN A RE- GEARSHIFTING COMMAND?
N
Y
507
TO 605
508
HAS SECOND/THIRD CLUTCH BEEN RELEASED?
N
Y
509
CONTROL ASSIST CLUTCH DURING RELEASE OF SECOND/THIRD CLUTCH
510
HAS THERE BEEN A RE- GEARSHIFTING COMMAND?
N
Y
511
TO 605
512
HAS SECOND/THIRD CLUTC BEEN ENGAGED?
N
Y
513
PERFORM ENGINE TORQUE RECOVERY CONTROL
514
HAS THERE BEEN A RE- GEARSHIFTING COMMAND?
N
Y
515
TO 601
516
HAS ENGINE TORQUE BEEN RECOVERED?
N
Y
517
FINISH PROCESSING OF FIRST GEARSHIFTING UNIT
END

FIG. 21


START
601
PERFORM ENGINE TORQUE DOWN CONTROL
602
603
N
HAS ENGINE TORQUE GONE DOWN?
N
HAS THERE BEEN A RE-GEARSHIFTING COMMAND?
Y
TO 501
604
Y
605
PERFORM FIRST CLUTCH RELEASE CONTROL
606
N
HAS FIRST CLUTCH BEEN RELEASED?
Y
607
PERFORM REVOLUTION SPEED CONTROL
608
N
IS REVOLUTION SPEED DIFFERENCE IN ALLOWABLE RANGE?
Y
609
PERFORM FIRST CLUTCH ENGAGEMENT CONTROL
610
N
HAS FIRST CLUTCH BEEN ENGAGED?
Y
611
PERFORM ENGINE TORQUE RECOVERY CONTROL
612
613
614
N
HAS ENGINE TORQUE BEEN RECOVERED?
N
HAS THERE BEEN A RE-GEARSHIFTING COMMAND?
Y
TO 501
Y
615
FINISH PROCESSING OF SECOND GEARSHIFTING UNIT
END